

Industrial control

Summary (2)

until end of SCADA

Smart Sensors Part 4

→ Benefits of silicon technology in smart sensors:-

- 1) single chip solution.
- 2) very small in size.
- 3) Less space in configuration.
- 4) work with small signals.

Why smart sensors

↳ It enhances the following:-

a) Self Calibration :- (desired $\overset{\text{Value}}{\cancel{\text{Value}}}$) \rightarrow self $\overset{\text{Jig}}{\cancel{\text{Jig}}}$ (deviation) \rightarrow self calibration

b) Communication \rightarrow bus status lines (info.) \rightarrow broadcast lines

c) Computation \rightarrow variance & average \rightarrow $\overset{\text{معنی}}{\cancel{\text{معنی}}}$ (mean) \rightarrow $\overset{\text{معنی}}{\cancel{\text{معنی}}}$ (standard deviation)

d) Multisensing \rightarrow temperature, pressure \rightarrow (measure) \rightarrow $\overset{\text{معنی}}{\cancel{\text{معنی}}}$ (measured values) \rightarrow gas flow & infrared (humidity),

e) Cost effective

\rightarrow Self (testing) \rightarrow self, self (Hardware) \rightarrow self test

* Smart sensor ~~is~~ Capable of

logic functions \rightarrow make decisions.

↳ two-way communication.

Components of smart sensors

1) Network Capable application Processor: (NCAP)

- ↳ communications
- ↳ interface control
- ↳ message routing
- ↳ TIM discovery & control.
- ↳ message encoding & decoding.

2) Transducer interface module (TIM)

- ↳ TEDS storage.
- ↳ Triggering.
- ↳ Data transfer.
- ↳ communications.
- ↳ Command Processing.
- ↳ Analog signal conditioning.

الجذع والأسنان (sensors) \rightarrow الجيل (Generations) \rightarrow المراقبة ←
(NCAP) \rightarrow المدخلات (IM) \rightarrow

Advantages of smart sensors

- a) High reliability.
- b) Easy to design, use and maintain.
- c) small rugged packaging.
- d) High Performance.
- e) scalable - flexible system.
- f) minimum Cost.
- g) minimum interconnecting cables.

* Disadvantages of smart sensors :-

- a) more complex than simple sensors (cause it consists of actuators and sensors)
- b) The complexity is much higher in the wired smart sensors \Rightarrow costs are also higher.

Applications of smart Sensors

1] Optical sensor

↳ used to measure exposure in cameras, optical angle encoders and optical arrays.

2] Infrared detector array (University of Michigan)

↳ ~~developed at solid laboratory~~ infrared sensing element is developed using Polysilicon.

3] Integrated multisensor (University of California)

↳ chip contains MOS devices for signal conditioning with on chip sensor.

Industrial apps. of smart sensors

1] Structural monitoring

↳ It is needed to detect damages of industrial infrastructure

2] Geological mapping

↳ needed to detect the minerals on the ~~geological~~ areas.

↳ Digital imaging & interpretation of tunnel geology.
↳ remote measurements of tunnel response.

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SCADA Part 1

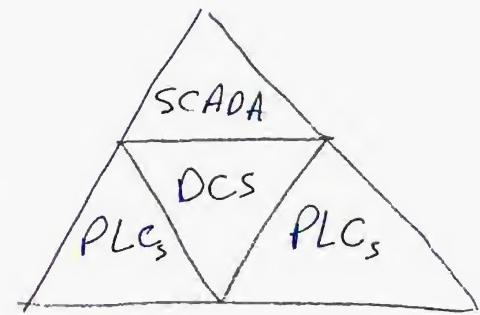
ا. (Control systems) جسم ایجاد کننده (industrial control) سیستم

- 1) PLC
- 2) DCS
- 3) SCADA

SCADA

↳ used in industrial processes such as
(Manufacturing, Power Generation
and distribution etc)

↳ also used in some experimental facilities
such as nuclear fusion.



Notes

↳ SCADA systems allow the operators to change the set points for the flow, and enable alarm conditions (such as loss of flow & high temperature)

↳ SCADA systems developed to run on DOS, VMS and UNIX, NT and Linux operating systems.

Hardware architecture

↳ It has two basic layers

① client layer

② Data server layer.

→ client layer: caters the human machine interaction

→ Data server layer: handles most of

↳ handles most of process data control activities.

↳ ~~communicate~~ Data servers communicate with devices in the field through process controllers. (~~with~~)

↳ Data servers are connected to each other and to client stations via Ethernet LAN or WAN.

(sub-systems of SCADA)

1) HMI

2) RTUs

3) PLCs

4) Communication infrastructure

HMI (Human machine interface)

↳ device which presents process data graphically to a human operator

↳ Through it, human operator monitors and controls the process.

↳ operator can see a schematic representation of the plant being controlled.

(BATMAN) فيلم (BATMAN: Dark Knight) ←
يستخدم شاشة تتبع عثمان يعرف مكان الجoker & خل مورجان
فريلان يتحكم في الشاشة الفريدة دى

RTUs (remote terminal units)

↳ nodes of distributed SCADA based systems used in remote locations & converting sensor signals of digital data & sending digital data to supervisory system. ↳ slave master device.

PLCs (Programmable logic controllers)

↳ control industrial equipment and processes.
↳ They are the primary components in smaller control system configurations.
↳ used extensively in almost all industrial processes.
↳ used as field devices cause they are more economical, flexible and configurable than special-purpose RTUs.

Communication infrastructure

↳ It connects the supervisory system to the remote terminal units.

Power supply Sources

- ↳ the preferred to SCADA is direct current (DC) station battery system.
- ↳ DC can be more reliable than (AC) alternating current.
- ↳ PLCs available with DC power supplies rated at voltages between (24 - 125) VDC.

Features of SCADA

- a) real-time & historical trending
- b) Alarms.
- c) security
- d) Dynamic process graphic.
- e) Data connectivity.
- f) Database connectivity.

* Real time & historical trending

- ↳ If your batch fails (or plant trips), you can simply go to historical trend data and do the analysis.

* Alarms

- ↳ we have alarm states for each I/P - O/P security.

- ↳ you can allocate certain facilities or features to operator, process people and maintenance dept

Application of SCADA system

- 1) Water management systems.
- 2) Electric Power.
- 3) Traffic signals.
- 4) mining Plants.
- 5) Environmental control systems.
- 6) Manufacturing systems.

a) water and Sewage:

↳ state water utilities use SCADA to monitor & regulate water flow, reservoir levels, pipe pressure and other factors.

b) Electric Power generation, transmission and distribution:

↳ electric utilities detect current flow and line voltage \Rightarrow to monitor the operation of circuit breakers & to take sections of the power grid online or offline.

c) Manufacturing

↳ manage parts inventories for Just-in-time manufacturing.

↳ regulate industrial automation & robots.

↳ monitor process & quality control.

Advantages of SCADA systems

- a) Easy maintained (self diagnostic)
- b) capability to do arithmetic function.
- c) Easily programmed and reprogrammed.
- d) ability to communicate with other controller or a master host computer.

SCADA Part 2

* What is network?

- ↳ interconnected system of computers.
- ↳ communication through specific protocols.
- ↳ better return ~~on~~ on investment.
- ↳ physical connectivity through copper/optical fiber or wireless media.

* Network security

- ↳ unauthorized access
- ↳ loss of integrity
- ↳ Denial of service.
- How to ensure security?
 - ↳ prevent a break-in, Put locks.
 - ↳ Have alarms to warn that a break-in has occurred.

* Basic security elements

- 1) Confidentiality 2) Integrity 3) Availability.

* Present security scenario (Notes)

- 1) dedicated networks are safe but expensive.
- 2) the internet is cheaper but comes with security risks.
- 3) Threats from external & internal users.
- 4) motivation is Political/monetary/or thrills.

* wireless networking

↳ becomes popular.

↳ remote monitoring and control applications.

↳ ex: pump control.

↳ easy to intercept wireless signals.

* similarities between industrial and business networks

- a) same owners & general goals.
- b) same technologies (TCP/IP, windows ... etc)
- c) common facilities.
- d) Interconnected at one or more points.

↳ security approach of both types have a lot of similarities.

* Differences between Industrial & Business networks

Industrial networks

- 1) Reliability and response time and safety.
- 2) better security through Proprietary operating systems.

Business networks

- 1) Availability & delivery of service.
- 2) Different risk management goals.

Organizational aspects of security

- security is not just a matter of technology.
- 1) security is not just a matter of technology.
 - 2) what is the probability of security incident?
 - 3) what are its risks?
 - 4) " is the cost for security systems, training and periodic testing
 - 5) Get the users to understand and cooperate.

Network security measures

- 1) authentication, authorization and accounting.
- 2) Encryption of data.
- 3) Intrusion detection & response
- 4) routers and firewalls for access control & filtering.
- 5) VLANs as a security solution for LANs.

Security testing

- ↳ It ensures that security implementation is effective.
- a) that security implementation is effective.
- b) " " follows organizational security policies

Issues

- ↳ when to test?
- ↳ what tests to conduct?
- ↳ How frequently?
- ↳ on which systems?
- ↳ who is responsible and for what?
- ↳ How much will it cost?

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SCADA Part 4

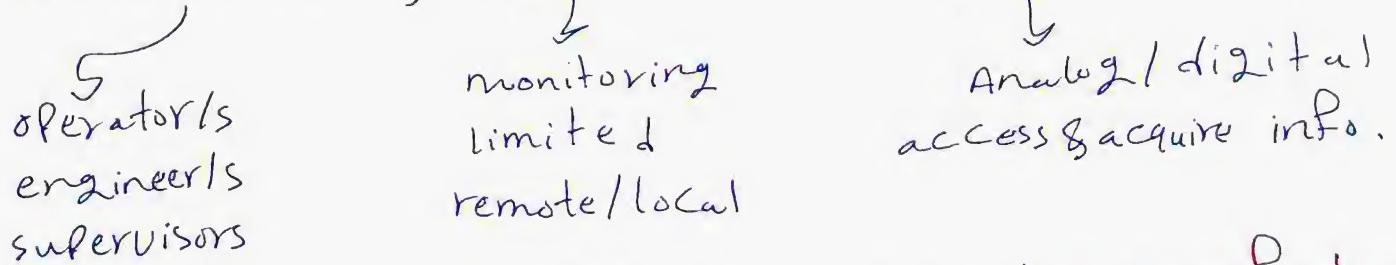
* Why Scada

↳ save time and money. ↳ reliable.

↳ supervisory control over a particular system.

* What is Scada

↳ supervisory control and data acquisition.



* Components manufacturers & system manufacturers of scada system?

↳ Automation solution. ↳ Software ↳ Hardware.

* Elements of SCADA

↳ sensors & actuators. ↳ RTUs / PLCs → to trip

↳ communication

↳ M/TU

↳ Front end processor.

↳ Scada server.

↳ Historical/redundant / safety server.

↳ HMI computer.

↳ HMI software.

Sensors

Types

- 1) Pressure sensors.
- 2) Temperature Sensors.
- 3) Light sensors.
- 4) Humidity sensors.
- 5) Wind speed sensors
- 6) Water level sensors.
- 7) Distance sensors.

Actuators

↳ values ↳ Pumps ↳ Motors.

Alarms

↳ critical failure alarms. ↳ Good alarms.

Safety instrumented Systems

Actions
↳ override the normal control system.

↳ Take over the actuators.

Communication

* Systems
1) Leased lines. 2) Internet 3) wireless Comm. systems.

*Protocols

1) TCP/IP 2) Ethernet 3) DirectNet
4) ModBus 5) Profibus.

Front-end Processor

- ↳ Gathers all Communications & convert them into SCADA Friendly communication.
- ↳ Communication interface between several RTU channels & the host master station computer.

SCADA SERVER

- ↳ It can be web server.
- ↳ real-time decision maker.

uses

- 1) Data Logging
- 2) Analyzing data.
- 3) serve the clients through a Firewall.

~~real time~~

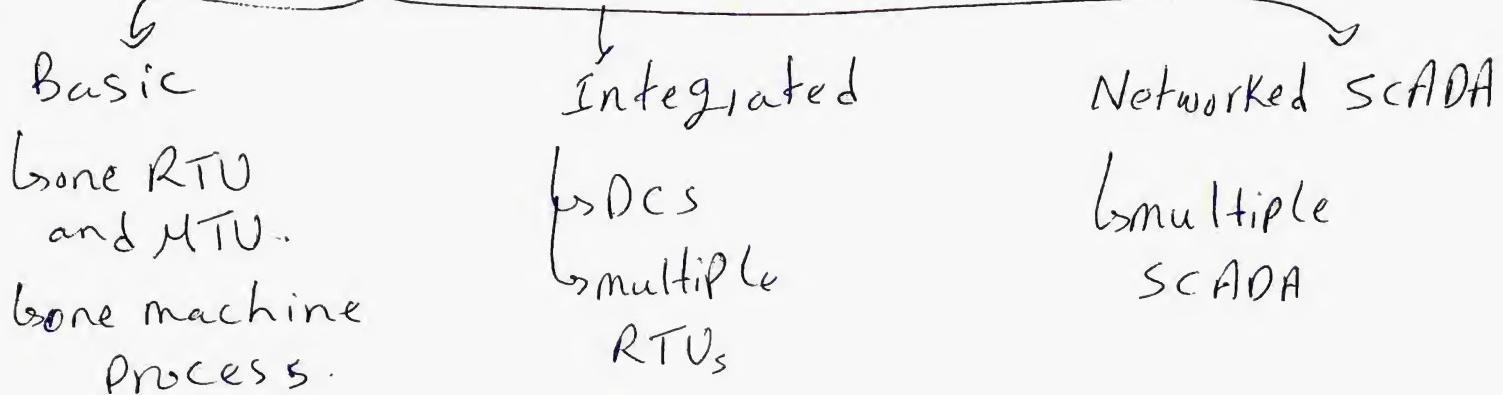
Historical Server

- ↳ logs the data from SCADA server & stores it as a backup, in case of disaster.
- ↳ safety server (basically)

HMI Computer

- 1) Access on the SCADA server.
- 2) control the system.
- 3) operator interface.
- 4) Software
 - ↳ user friendly.
 - ↳ programmable (C, C++)

SCADA types



لآخر خايل هو فيه جابه مستمر و فيه صور
لجاج = الباب يطلع عليه

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